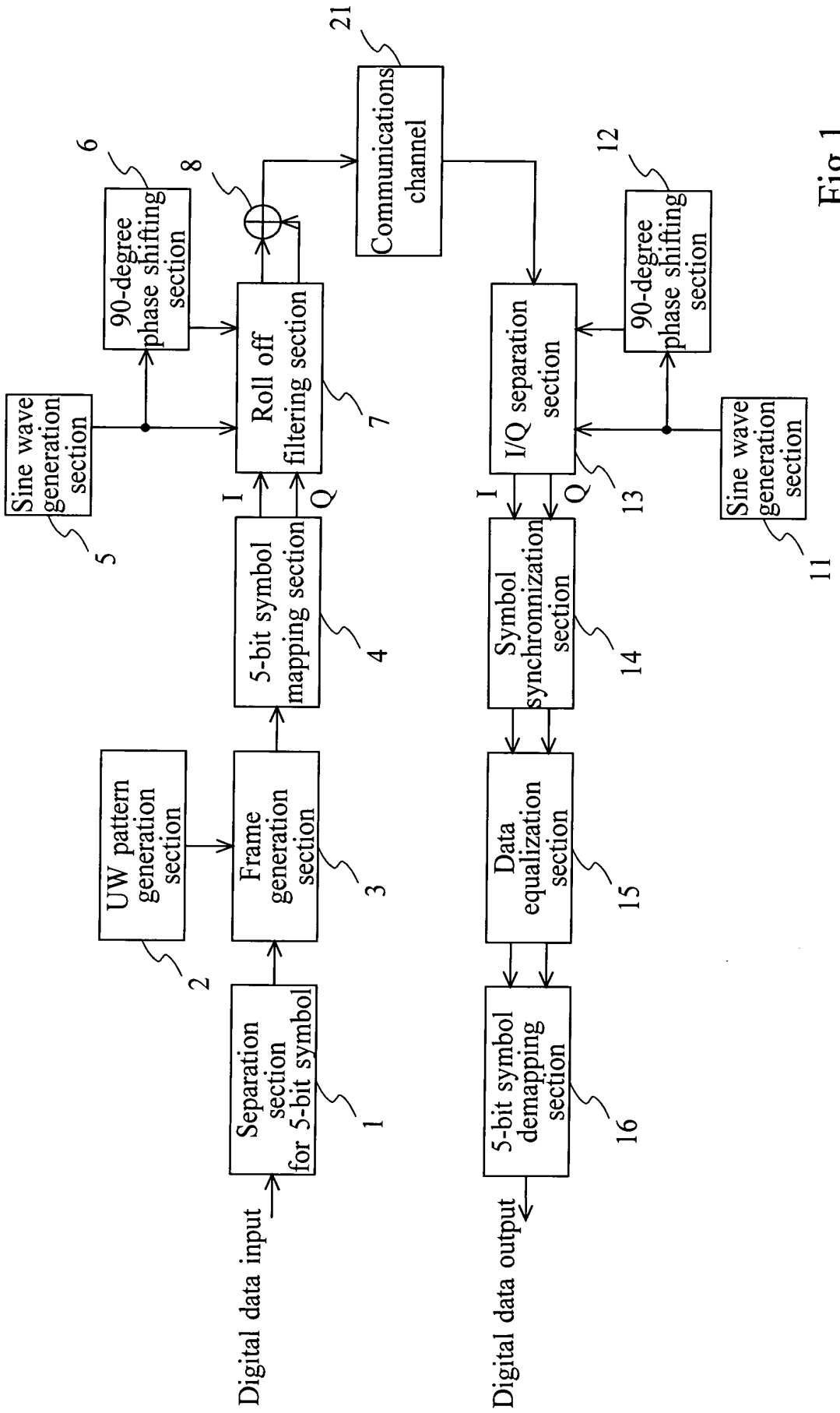

Digital data input
Separation section for 5-bit symbol
1
UW pattern generation section
2
Frame generation section
3
5-bit symbol mapping section
4
I
Q
Roll off filtering section
7
8
90-degree phase shifting section
6
Sine wave generation section
5
Communications channel
21
I/Q separation section
13
I
Q
Symbol synchronization section
14
Data equalization section
15
5-bit symbol demapping section
16
Digital data output
90-degree phase shifting section
12
Sine wave generation section
11

Fig.1

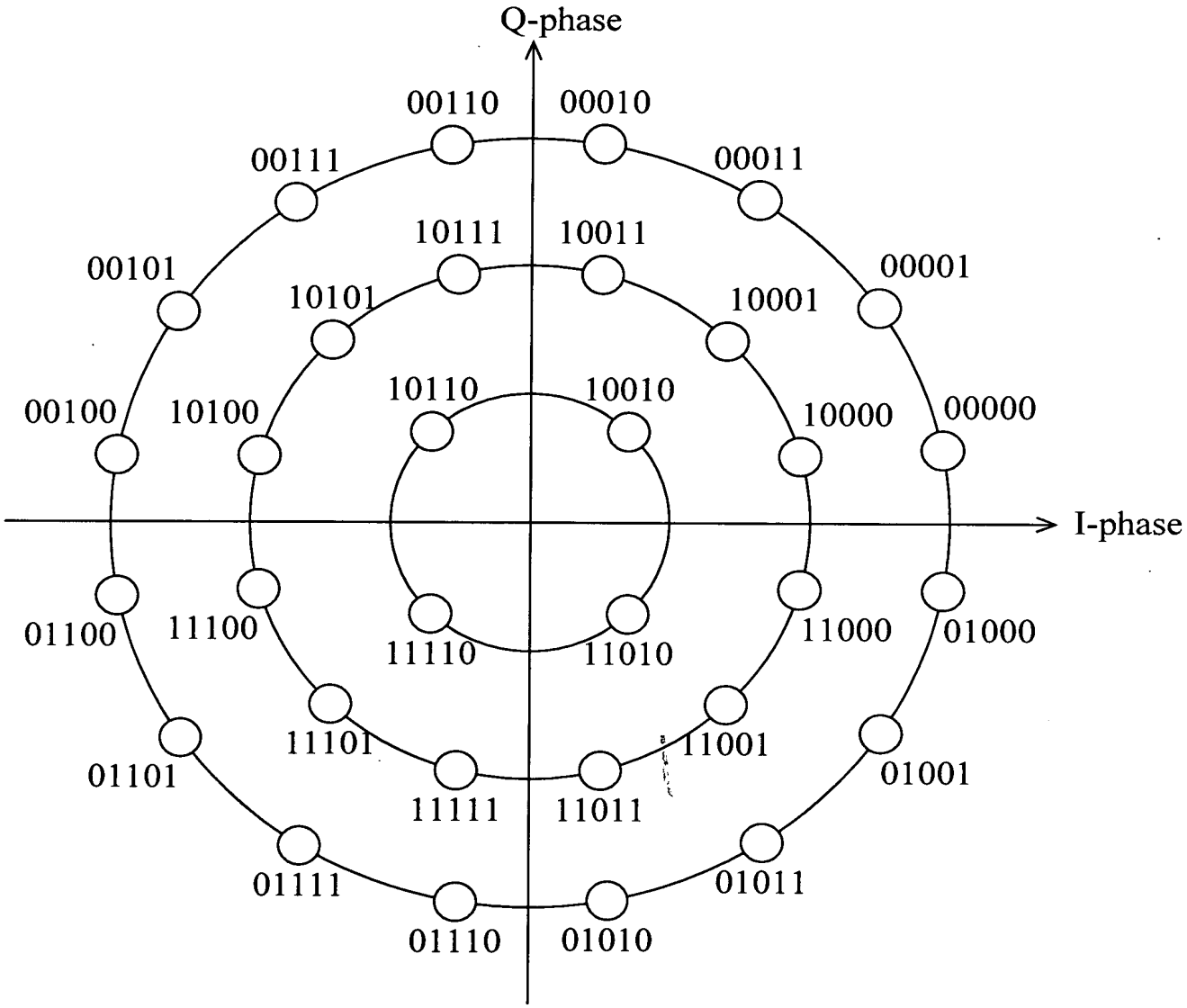
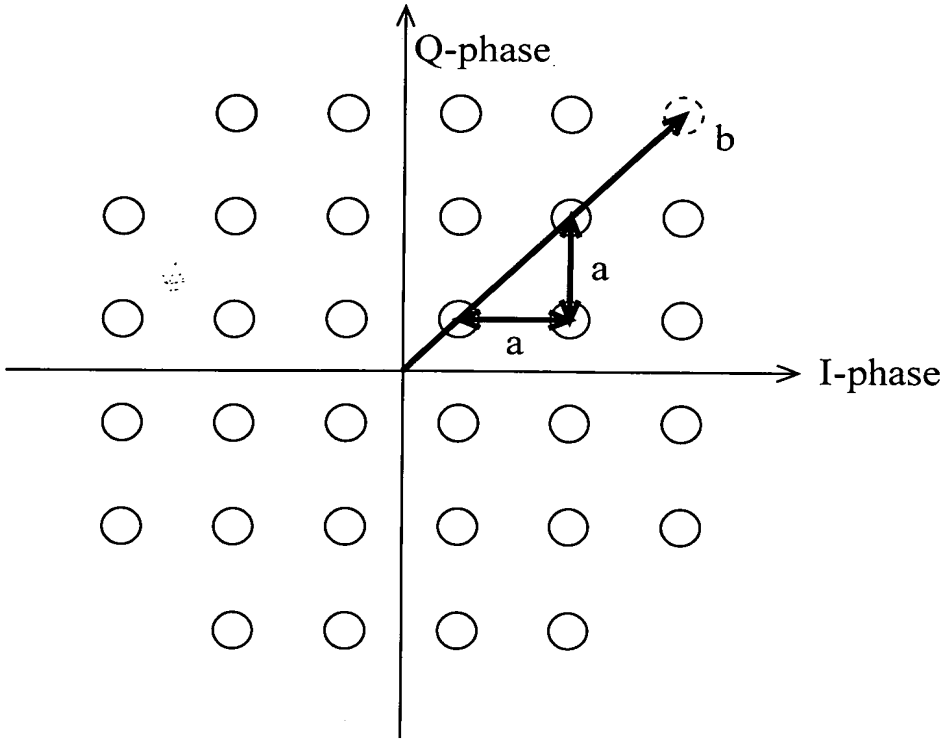

Q-phase
I-phase
00110
00010
00111
00011
10111
10011
00101
00001
10101
10001
10110
10010
00100
10100
10000
00000
01100
11100
11110
11010
11000
01000
11101
11001
01101
01001
11111
11011
01111
01011
01110
01010

Fig.2

(a)



(b)

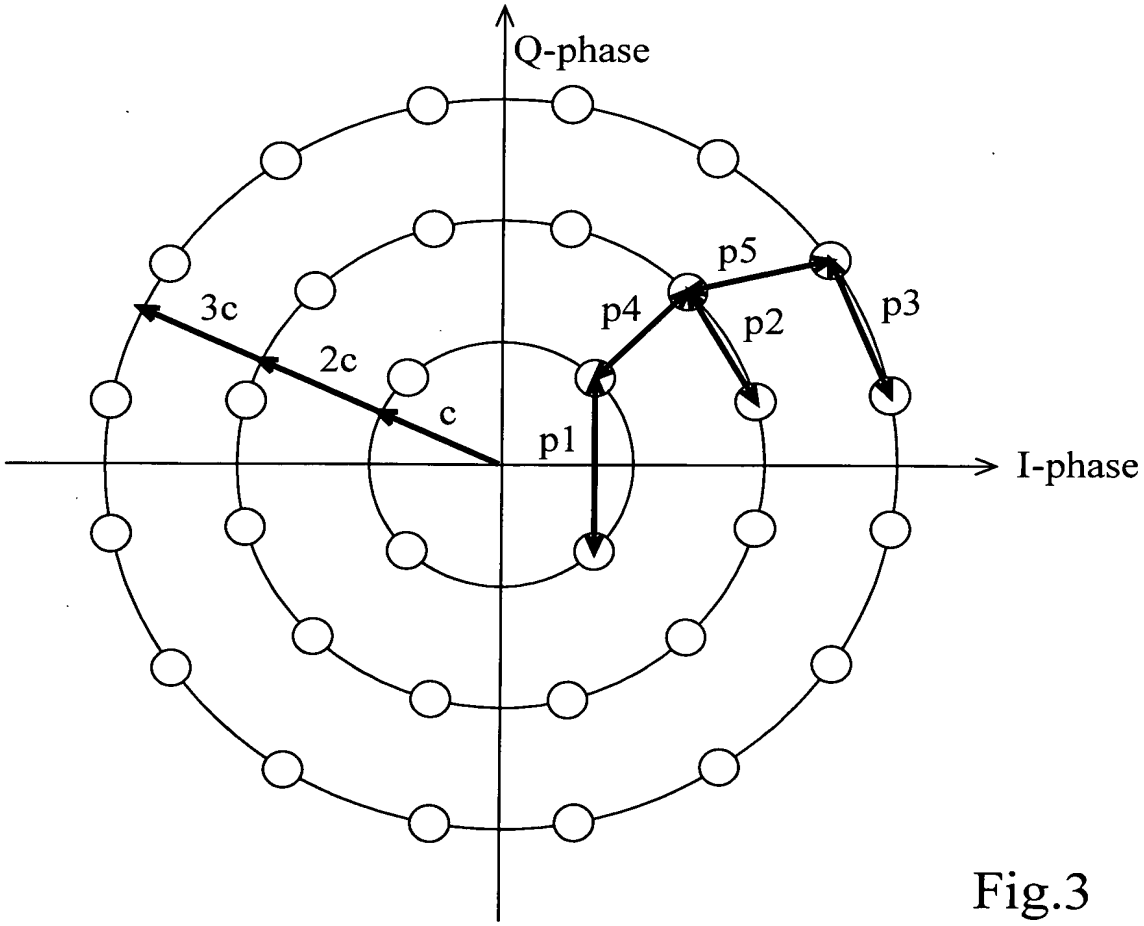


Fig.3

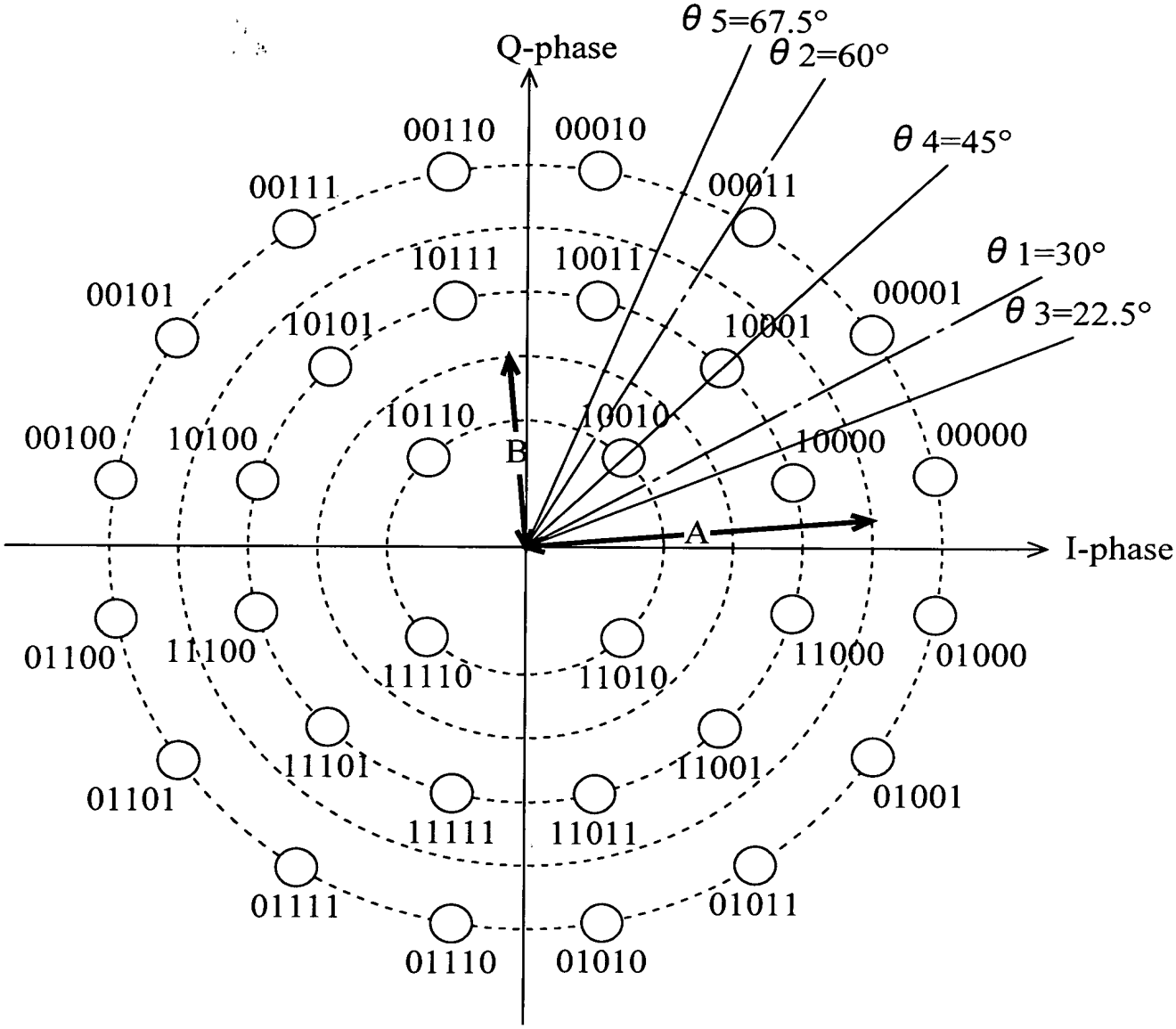

θ 5=67.5°
θ 2=60°
θ 4=45°
θ 1=30°
θ 3=22.5°
Q-phase
I-phase
A
B
00110
00010
00111
00011
10111
10011
00101
00001
10101
10001
10110
10010
00100
10100
10000
00000
01100
11100
11110
11010
11000
01000
11101
11001
01101
01001
11111
11011
01111
01011
01110
01010

Fig.4

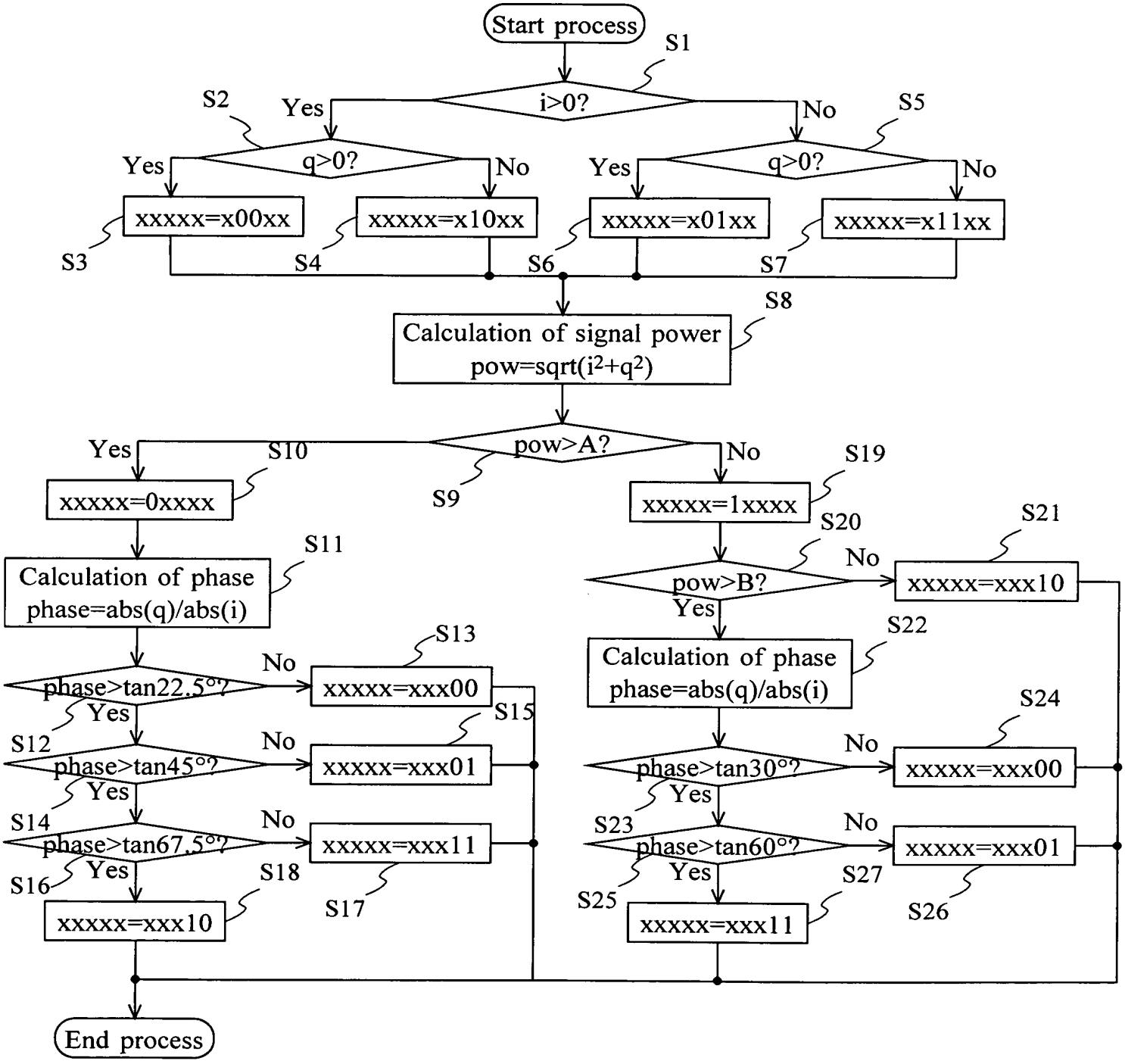

Start process
S1
i>0?
Yes
No
S2
S5
q>0?
q>0?
Yes
No
Yes
No
xxxxx=x00xx
xxxxx=x10xx
xxxxx=x01xx
xxxxx=x11xx
S3
S4
S6
S7
S8
Calculation of signal power
pow=sqrt(i²+q²)
pow>A?
Yes
No
S9
S10
S19
xxxxx=0xxxx
xxxxx=1xxxx
S11
S20
S21
Calculation of phase
phase=abs(q)/abs(i)
pow>B?
No
xxxxx=xxx10
Yes
S22
Calculation of phase
phase=abs(q)/abs(i)
S13
S24
No
No
phase>tan22.5°?
xxxxx=xxx00
phase>tan30°?
xxxxx=xxx00
Yes
Yes
S12
S15
S23
No
No
phase>tan45°?
xxxxx=xxx01
phase>tan60°?
xxxxx=xxx01
Yes
Yes
S14
S25
S27
No
No
phase>tan67.5°?
xxxxx=xxx11
xxxxx=xxx11
Yes
Yes
S16
S18
S17
S26
xxxxx=xxx10
End process

Fig.5

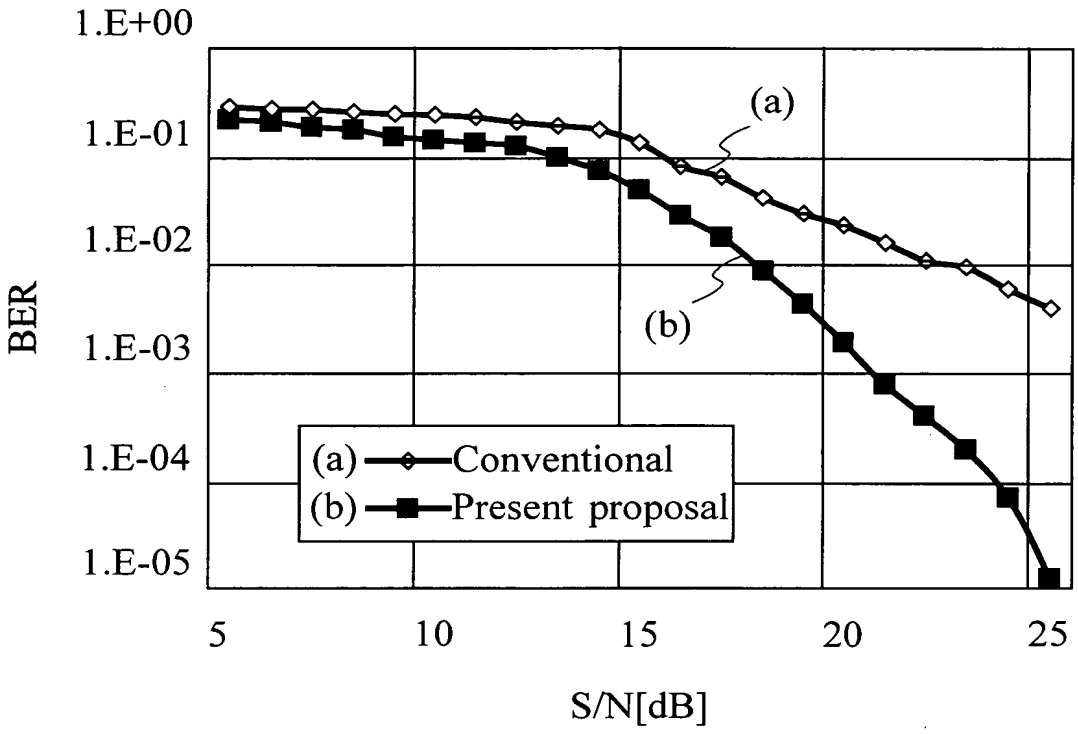

1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
BER
5
10
15
20
25
S/N[dB]
(a)
(b)
(a) Conventional
(b) Present proposal

Fig.6

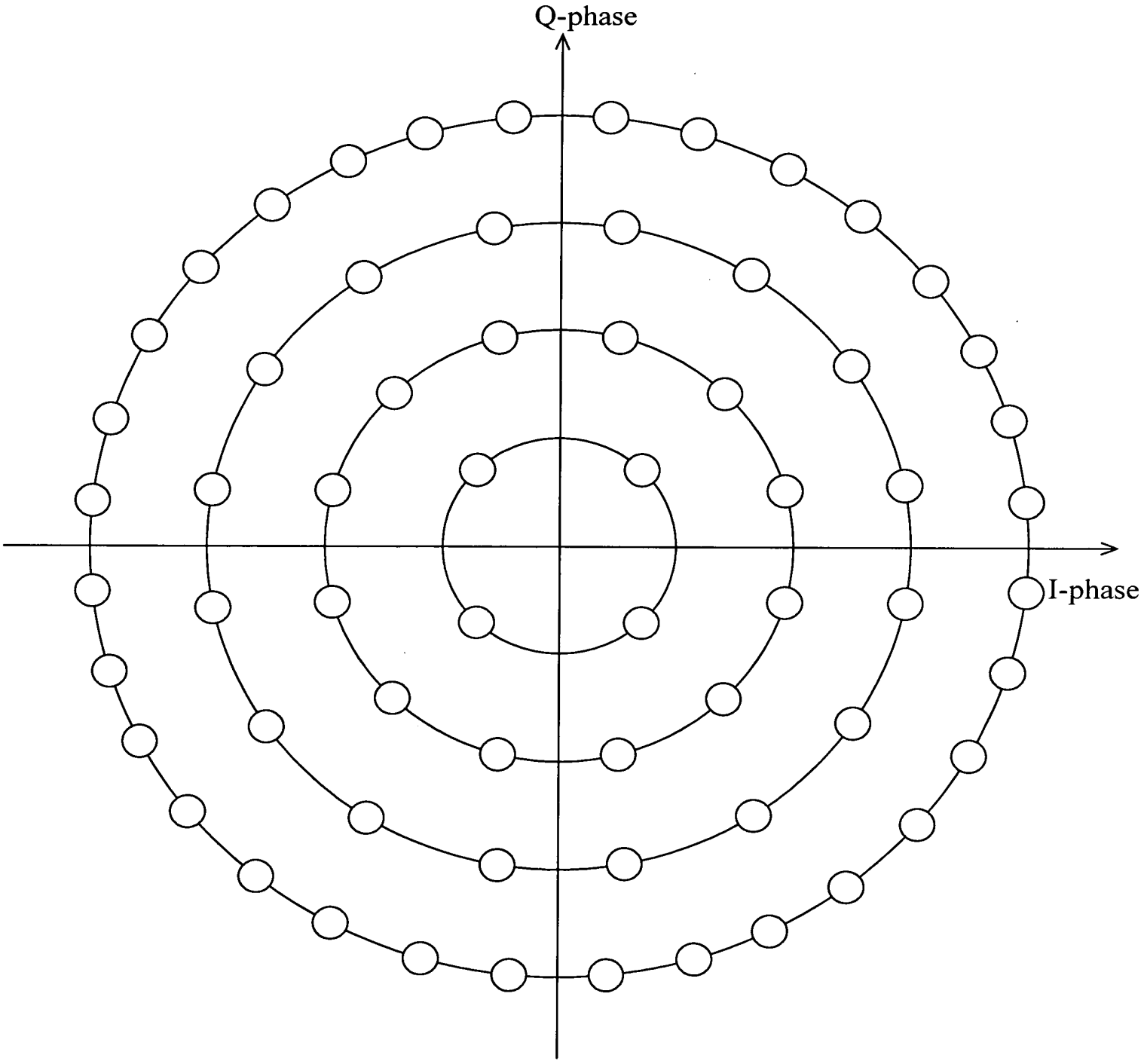


Fig.7

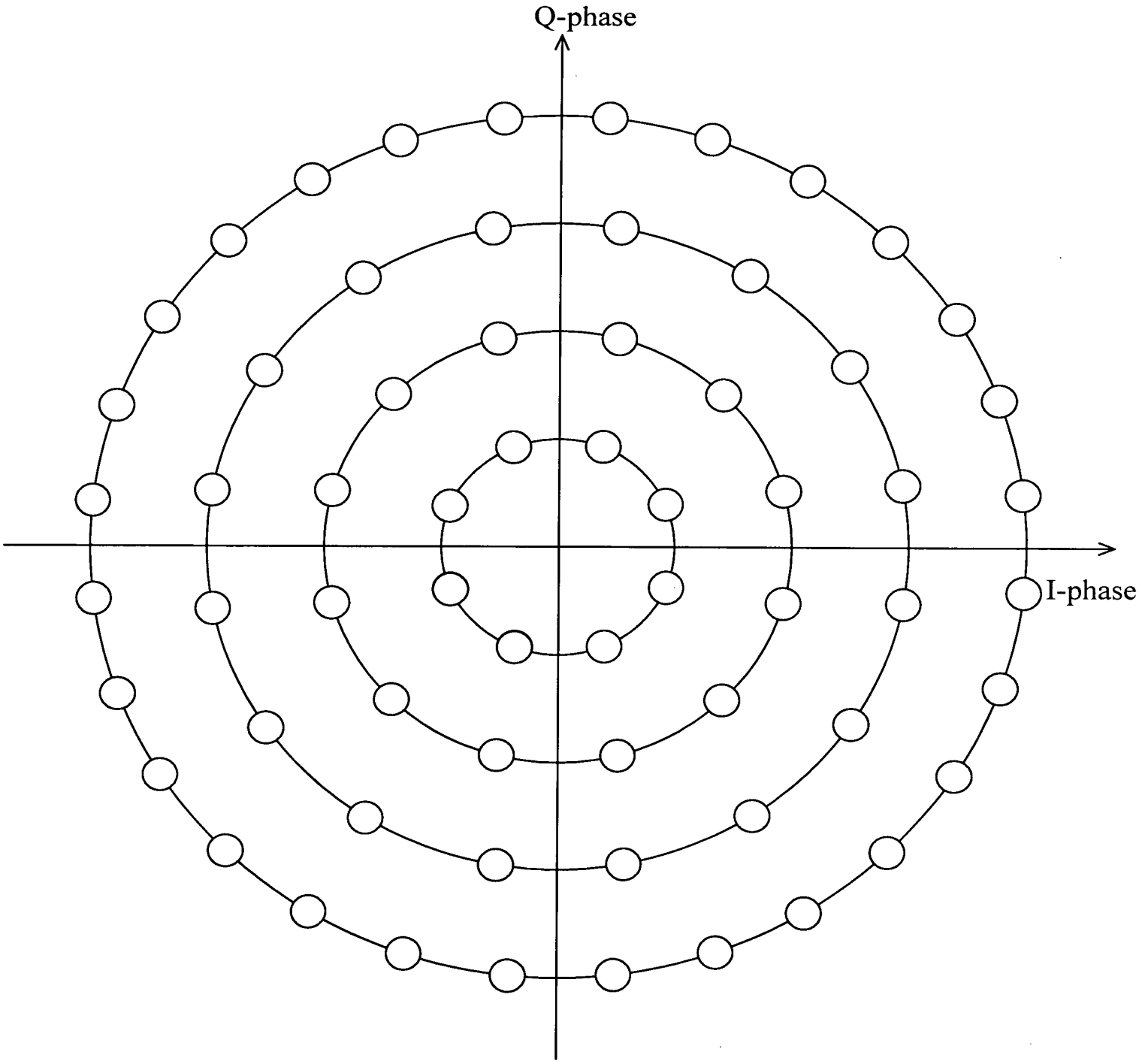


Fig.8

Exemplary specification of 32 QAM and 64 QAM when 9.6 kbps is realized		
Item	32QAM	64QAM
Sampling frequency	16kHz	16kHz
Over sample	8-Times	8-Times
Keying	2kbaud	2kbaud
Entire bit rate	10kbps	12kbps
Redundant information rate	0.4kbps	2.4kbps
Redundant information : data ratio	1:24	1:4

Fig.9

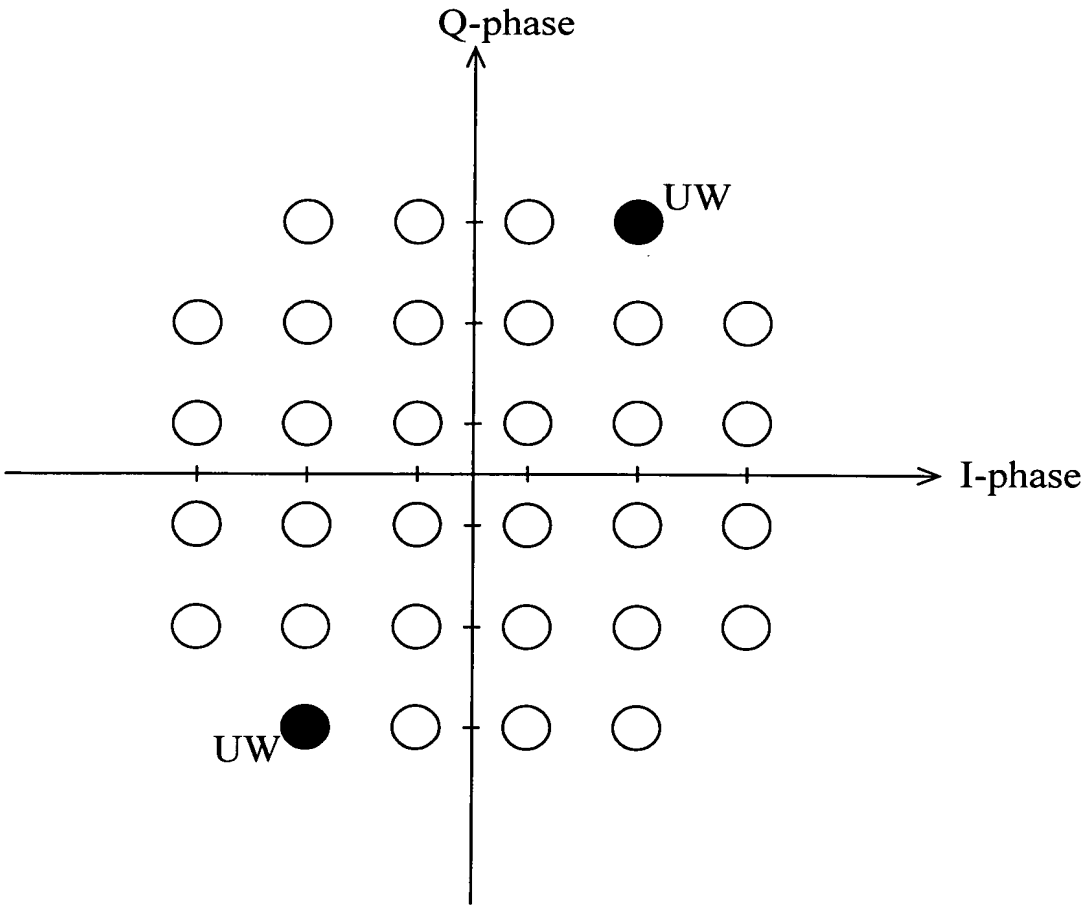


Fig.10

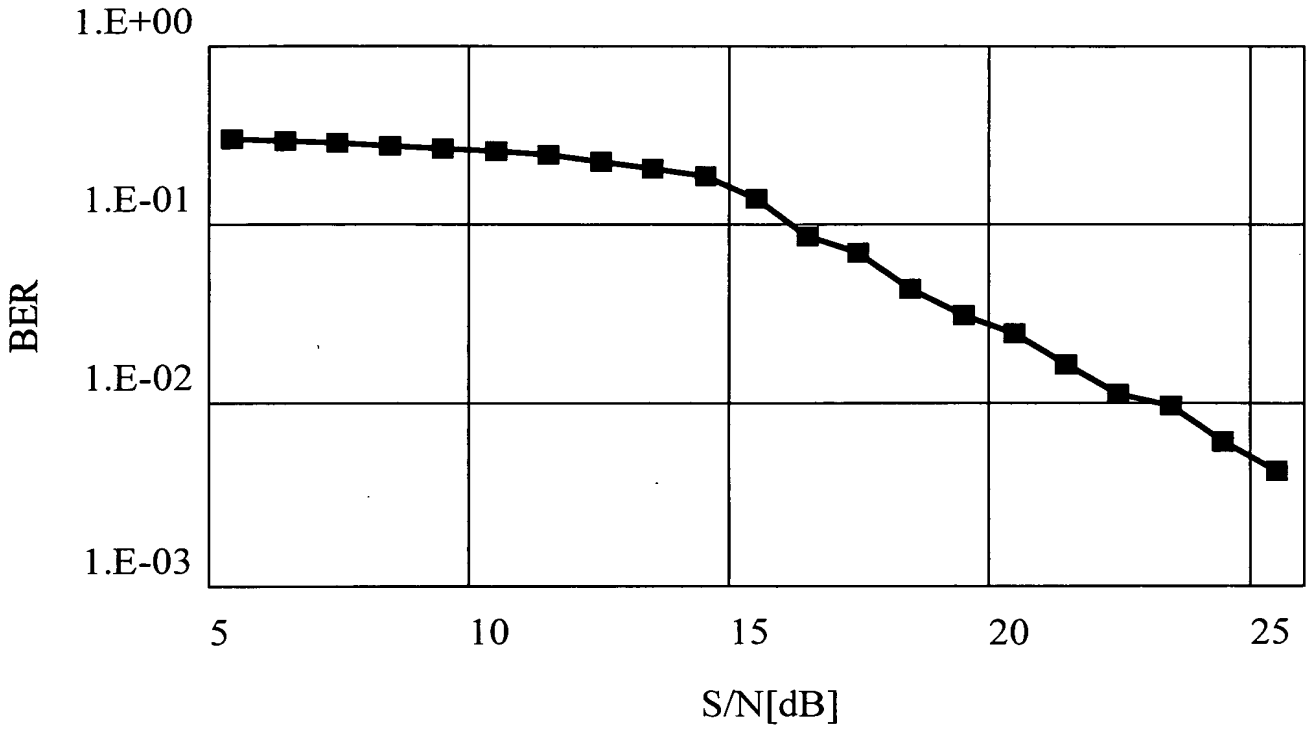


Fig.11